

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

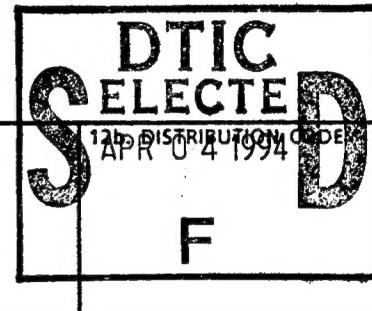
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1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	February 22, 1995	Final Technical Report May 1994-Jan 1995
4. TITLE AND SUBTITLE		5. FUNDING NUMBERS
Emerging Applications in Probability (Sensor Management)		F49620-94-1-0275  2304/ES 61102F
6. AUTHOR(S)		
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)		8. PERFORMING ORGANIZATION REPORT NUMBER
Institute for Mathematics and Its Applications University of Minnesota - 514 Vincent Hall, 206 Church St. Minneapolis, MN Unisys Government Systems Group P. O. Box 64525 MS U1N28 St. Paul, MN 55164-0525		AFOSR TR IMA/Unisys Final Report-1
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSORING/MONITORING AGENCY REPORT NUMBER
Air Force Office of Scientific Research 110 Duncan Avenue, Suite B115 Bolling AFB, DC 20332		F49620-94-1-0275

## 11. SUPPLEMENTARY NOTES

## 12a. DISTRIBUTION / AVAILABILITY STATEMENT

Distribution Unlimited



## 13. ABSTRACT (Maximum 200 words)

This grant from the Air Force Office of Scientific Research supported research in Sensor Management related to the IMA 1993-94 academic year program "EMERGING APPLICATIONS OF PROBABILITY". It provided partial support for residency of Keith Kastella, an industrial researcher at Unisys Government Systems, to pursue research on the use of discrimination gain optimization for sensor management in Air Traffic Control, Manufacturing, Robotics, Remote Sensing and Defense Applications.

Grant AF/F49620-94-1-0275 supported the publication of a technical research report submitted by Dr. Kastella for inclusion in the IMA Preprint Series. This paper has been submitted to the IEEE Transactions on Systems, Man and Cybernetics.

**19950403 043**

14. SUBJECT TERMS			15. NUMBER OF PAGES
Data Fusion, Bayesian statistics, classical probability, discrimination, Kullback-Leibler information, information theory			2
16. PRICE CODE			
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

## INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

## UNISYS GOVERNMENT SYSTEMS GROUP

- (1) CONTRACT OR GRANT NUMBER: AF/F49620-94-1-0275
- (2) PERIOD COVERED BY REPORT: May 1994-Jan 1995
- (3) GRANT TITLE: EMERGING APPLICATIONS IN PROBABILITY (SENSOR MANAGEMENT)
- (4) NAME OF INSTITUTION: UNIVERSITY OF MINNESOTA, MINNEAPOLIS / UNISYS  
GOVERNMENT SYSTEMS GROUP, ST PAUL, MN
- (5) AUTHOR OF REPORT: KEITH KASTELLA

The following manuscript has been submitted to the refereed journal *IEEE Transactions on Systems, Man, and Cybernetics*. It will be published in the IMA Preprint Series:

1288 Keith Kastella, "Discrimination Gain to Optimize Detection and Classification."

**ABSTRACT:** A method for managing agile sensors to optimize detection and classification based on discrimination gain is presented. Expected discrimination gain is used to determine threshold settings and search order for a collection of discrete detection cells. This is applied in a low signal-to-noise environment where target-containing cells must be sampled many times before a target can be detected or classified with high confidence. The goal of sensor management is interpreted to be to direct sensors to optimize the probability densities produced by a data fusion system that they feed. The use of discrimination is motivated by its interpretation as a measure of the relative likelihood for alternative probability densities. This is studied in a problem where a single sensor can be directed at any detection cell in the surveillance volume for each sample. Bayes rule is used to construct a recursive estimator for the cell target probabilities. The expected discrimination gain is predicted for each cell using its current target probability estimates. This gain is used to select the optimal cell for the next sample. For thresholded data, the expected discrimination gain depends on the threshold which is selected to maximize the gain for each sample. The expected discrimination gains can be maintained in a binary search tree structure for computational efficiency. The computational complexity of this algorithm is proportional to the height of the tree which is logarithmic in the number of detection cells. In a test case for a single 0 dB Gaussian target, the error rate for discrimination directed search was similar to the direct search result against a 6 dB target.

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